North Carolina Department of Transportation
Transportation Planning Branch

Thoroughfare Plan

Study Report for the Town of Norlina

December 2004

Thoroughfare Plan
Study Report
for the
Town of Norlina

Prepared by the: Transportation Planning Branch
N.C. Department of Transportation

In Cooperation with: The Town of Norlina
Kerr-Tar Rural Planning Organization
The Federal Highway Administration
U.S. Department of Transportation

December 2004

Acknowledgments

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Executive Summary

In March of 2003, the Transportation Planning Branch of the North Carolina Department of Transportation and the town of Norlina made a formal agreement to begin the Norlina Thoroughfare Plan. The resulting thoroughfare plan, as shown in **Figure 2**, resulted from the implementation of the thoroughfare planning principles.

This report documents the findings of this study, along with the resulting recommendations for improvements. In addition, this report presents transportation cross-section recommendations, cost estimates for the recommended improvements, and environmental features found in the recommended improvement area.

The recommendations for improvement are listed below. A more detailed discussion of these recommendations can be found in **Chapter 2**.

- **US 158 Bypass**: Proposed realignment of US 158 around the southwestern edge of the town limits from US 1/US 158 to US 158 Business/US 401. The new location facility will be a four lane divided section.

- **US 1/US 158 Widening**: Widen to a four lane divided section from the western study area boundary to the US 158 Bypass.

- **US 158 Widening**: Widen to a four lane divided section from US 158 Business/US 401 to the eastern study area boundary.

- **US 158 Business/US 401 Widening**: Widen to a four lane divided section from US 158 to the southern planning area boundary.

- **US 158 Business/US 401 Realignment**: Realign US 158 Business/US 401 at the intersection of the proposed US 158 Bypass.

After coordination with town officials and several informational meetings with the Council Members and citizens of Norlina, the Norlina Thoroughfare Plan was adopted by the Norlina Town Council on November 1, 2004. This plan was adopted by the North Carolina Board of Transportation on December 2, 2004.

Implementation of the plan rests largely with the town and citizens. The town should work with the Kerr-Tar Rural Planning Organization to prioritize their needs. This organization is responsible for presenting the needs to the Department of Transportation for consideration. Transportation needs throughout the State exceed the available funding; therefore, local areas should aggressively pursue funding for the projects they desire.

I. Introduction

An area's transportation system is its lifeline, contributing to its economic prosperity and social well being. The importance of a safe and efficient transportation infrastructure cannot be overstressed. This system provides a means of transporting people and goods from one place to another quickly, conveniently, and safely. A well-planned system will meet the existing travel demands, as well as keep pace with the growth of the region. The town of Norlina recognized the importance of this process of planning for future transportation needs and requested transportation planning assistance from the Transportation Planning Branch of the North Carolina Department of Transportation (NCDOT) in March 2003.

The town of Norlina is located in the northwestern portion of Warren County, east of I-85. The town is approximately 15 miles northeast of Henderson and approximately 4 miles northwest of Warrenton. The geographical location is shown in **Figure 1**.

This report documents the development of the 2003 Norlina Thoroughfare Plan shown in **Figure 2**. This is Norlina's first thoroughfare plan. A thoroughfare plan is developed to ensure that the transportation system will be progressively developed, meeting the needs of the town. It will serve as an official guide to providing a well-coordinated, efficient, and economical roadway system. This document will be utilized by local officials to ensure that planned transportation facilities reflect the needs of the public, while minimizing the disruption to local residents, businesses, and the environment.

The purpose of this study is to examine present and future transportation needs of the area and develop a thoroughfare plan to meet these needs. The plan recommends those improvements that are necessary to provide an efficient transportation system within the 2003-2035 planning period. The recommended cross-sections outlined in **Appendix B** for these improvements are based on existing conditions and projected traffic volumes.

The thoroughfare plan is based on the projected growth as forecasted through the cooperative effort between the NCDOT and town leaders. It is possible that actual growth patterns will differ from those logically anticipated. As a result, it may be necessary to accelerate or delay the development of some recommendations found on the plan. Some portions of the plan may require revisions in order to accommodate unexpected changes in urban development.

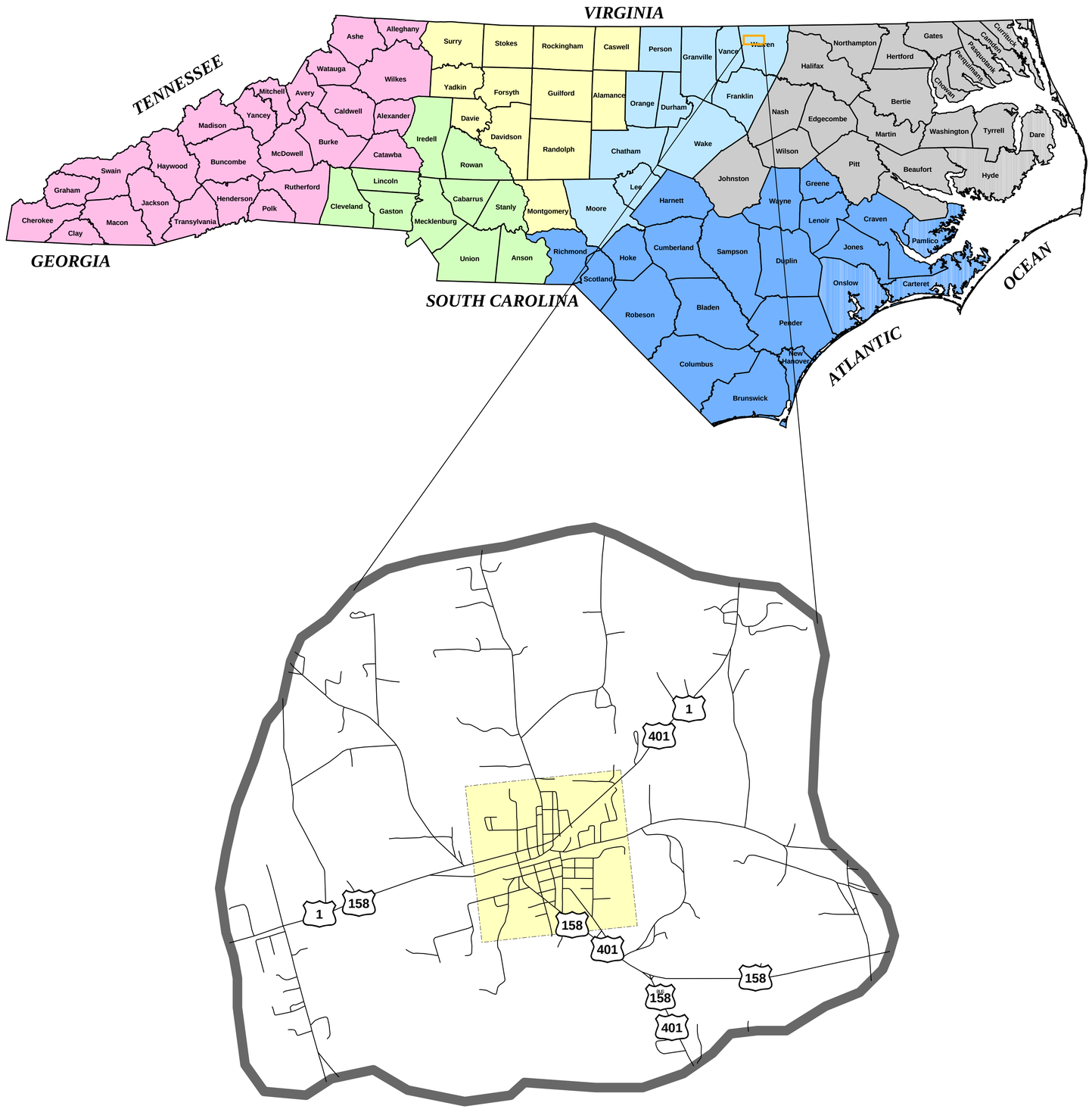

FIGURE 1

GEOGRAPHIC LOCATION

N
W E
S

LEGEND

- METROLINA
- MOUNTAINS
- NORTHEAST
- SOUTHEAST
- TRIAD
- TRIANGLE

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

BASE MAP DATE: NOVEMBER 2004

LEGEND

	Existing	Proposed
Major Thoroughfare	———	- - - -
Minor Thoroughfare	———	- - - -
Grade Separation	○	○
Interchange	●	●

ADOPTED BY:

TOWN OF NORLINA	November 1, 2004
RECOMMENDED BY TRANSPORTATION PLANNING BRANCH	November 19, 2004
N.C. DEPARTMENT OF TRANSPORTATION	December 2, 2004
COORDINATED WITH KERR-TAR RPO	November 18, 2004
PUBLIC HEARING	November 1, 2004

September 9, 2004

FIGURE 2

THOROUGHFARE PLAN

TOWN OF

NORLINA

WARREN COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 400 800 1600 2400 3200 Feet

BASE MAP DATE: AUGUST 2004

II. Recommendations

This chapter contains recommended improvements based on the ability of the existing roadway system to serve existing and anticipated travel desires as the area continues to grow. The adopted plan represents the highway element of a transportation system that will serve the anticipated traffic and land development needs. The primary objective of this plan is to reduce traffic congestion and improve safety by eliminating both existing and projected deficiencies in the transportation system.

The recommended highway improvements are presented in **Figure 3**. See **Appendix B** for a highway inventory of the recommendations and **Appendix C** for a listing of typical cross-sections used by NCDOT.

The process of determining and evaluating recommendations for the roads in the thoroughfare plan involves many considerations including the goals and objectives of the public in the area, existing roadway conditions, identified roadway deficiencies, environmental impacts and existing and anticipated land development. Consideration of these factors led to the development of a mutually adopted plan.

US 158 Bypass

Project Recommendation: It is recommended that a new four lane divided control of access facility be constructed around the southwestern edge of the town limits from US 1/US 158 to US 158 Business/US 401. The project limits combine for a total of approximately 1.90 miles with an estimated cost of $11.4 million.

Transportation Demand: The proposed US 158 Bypass is intended to improve the east-west travel along US 158 through Norlina and Warren County. This facility will help reduce congestion in downtown Norlina and along US 158 Business/US 401 and US 1/US 158.

Roadway Capacity and Deficiencies: The 2035 traffic on this proposed route is anticipated to be approximately 13,000 vehicles per day (vpd). If no roadway improvements are made many of the existing roadway facilities, including US 158 and US 401 will be over capacity by the year 2035. If this facility is not constructed, the level of service along existing roadway facilities will deteriorate over time if traffic growth continues as expected.

Safety Issues: The US 158 Bypass will remove some of the current and projected traffic from US 158 Business/US 401 and US 1/US 158 thus reducing the potential for crashes. Control of access along the proposed facility will ensure that crossings will only be at regulated locations that can be controlled

through signalization or channelization. The elimination of driveways should decrease crashes due to vehicles slowing to turn into driveways, or slower vehicles turning into higher speed traffic.

Social Demands and Economic Development: It is anticipated that the proposed US 158 Bypass will bring new growth and economic development to the town. As development occurs it is important that control of access on the facility is implemented to allow for greater capacity through the control of traffic movements.

System Linkage: The proposed US 158 Bypass will provide an additional east-west corridor across the town, allowing people to move more efficiently. This facility will allow traffic to bypass the town without having to travel through the downtown area and along the congested portions of US 158 Business/US 401 and US 1/US 158. This project should be completed in conjunction with the US 1/US 158 widening and the US 158 widening described later in this chapter.

Relationship to Other Plans: This proposed facility is listed in the 2004-2010 Transportation Improvement Program (TIP) as project R-2587. A feasibility study for this project was completed in 1998. The location of the proposed facility shown in the feasibility study is different from the location of the proposed facility shown in this report. US 158 is an intrastate system facility, meaning this route is important on a regional and statewide scale. US 158 is also identified as a Strategic Highway Corridor.

US 1/US 158 Widening

Project Recommendation: It is recommended that US 1/US 158 be widened to a four lane divided facility from the western study area boundary to the proposed US 158 Bypass. The project is approximately 0.91 miles in length. The estimated cost for this project is $4.4 million.

Transportation Demand: This route is projected to carry 19,000 vpd in the year 2035. Without any improvements this route will be over capacity in the year 2035 and the level of service will deteriorate if traffic growth continues as expected.

Roadway Capacity and Deficiency: US 1/US 158 is a major highway facility in Warren County. Portions of this facility will be near or over capacity in the year 2035 if growth continues as projected.

Safety Issues: If no improvements are made to US 1/US 158, the resulting increase in congestion will create the potential for increased crash rates. The widening of this facility will provide increased capacity and greater maneuverability resulting in safer driving conditions.

Social Demands and Economic Development: In conjunction with the other recommendations in this report, the widening of US 1/US 158 should have a positive impact on economic development, and in improve automobile transportation in the town of Norlina and in Warren County.

System Linkage: US 1/US 158 is a major east-west route in Warren County and provides a connection to I-85 for the residents. This project should be completed in conjunction with the US 158 Bypass and the US 158 widening described in this chapter.

Relationship to Other Plans: This is a new recommendation. This recommendation is not identified on any other thoroughfare plans or in the 2004-2010 TIP. US 158 is an intrastate system facility, meaning this route is important on a regional and statewide scale. US 158 is also identified as a Strategic Highway Corridor, thus new access points should be limited on this section of the facility.

US 158 Widening

Project Recommendation: It is recommended that US 158 be widened to a four lane divided facility from US 158 Business/US 401 to the eastern study area boundary. The project limits combine for a total of approximately 1.54 miles with an estimated cost of $6.6 million.

Transportation Demand: The widening of this route will help improve the east-west travel along US 158 through Norlina and Warren County.

Roadway Capacity and Deficiencies: The 2035 traffic on this route is anticipated to be approximately 9,500 to 15,000 vpd depending on location. Without any improvements, the level of service by 2035 will deteriorate if traffic growth continues as expected.

Safety Issues: If no improvements are made to US 158, the resulting increase in congestion will create the potential for increased crash rates. The widening of this facility will provide increased capacity and greater maneuverability resulting in safer driving conditions.

Social Demands and Economic Development: In conjunction with the other recommendations in this report, the widening of US 158 should have a positive impact on economic development, and improve automobile transportation in the town of Norlina and Warren County.

System Linkage: As a major intrastate facility, US 158 provides a connection from Norlina and Warren County to points east and west throughout the state.

Relationship to Other Plans: This proposed widening is included in the 2004-2010 Transportation Improvement Program (TIP) as part of project R-2587.

US 158 is an intrastate system facility, meaning this route is important on a regional and statewide scale. US 158 is also identified as a Strategic Highway Corridor, thus new access points should be limited on this section of the facility.

US 158 Business/US 401 Widening

Project Recommendation: It is recommended that US 158 Business/US 401 be widened to a four lane divided facility from the US 158 Bypass intersection to the southern study area boundary. The project limits combine for a total of approximately 0.60 miles with an estimated cost of $3.2 million.

Transportation Demand: The widening of this section of US 158 Business/ US 401 will help improve the north-south travel between Norlina and Warrenton. Due to the close proximity of Norlina and Warrenton this route carries many home to work and shopping trips. The widening of this route will improve access to Warrenton, the county seat.

Roadway Capacity and Deficiencies: This route is projected to carry 11,000 vpd by the year 2035. Without any improvements, the level of service by the year 2035 will deteriorate if traffic growth continues as expected.

Safety Issues: If no improvements are made to US 158 Business/US 401, the resulting increase in congestion will create the potential for increased crash rates. The widening of this facility will provide increased capacity and greater maneuverability resulting in safer driving conditions.

Social Demands and Economic Development: In conjunction with the other recommendations in this report, the widening of US 158 Business/US 401 should have a positive impact on economic development, and improve automobile transportation in the town of Norlina and Warren County.

System Linkage: This route provides an important connection between Norlina and Warrenton as well as a connection to other major roadway facilities in the county such as US 1, US 158, and NC 58.

Relationship to Other Plans: The widening of US 158 Business/US 401 is also a recommendation on the Warrenton Transportation Plan. This recommendation is not identified in the TIP.

Other Recommendations

- **US 158 Business/US 401:** To improve traffic flow and safety it is recommended to realign US 158 Business/US 401 at the intersection of the proposed US 158 Bypass. This realignment will allow the proposed US 158 Bypass to intersect US 158 Business/US 401 at a right angle. This realignment will improve sight distance, thus improving traffic flow, capacity, and safety.

NCDOT TPB
TRANSPORTATION PLANNING BRANCH

FIGURE 3

RECOMMENDED IMPROVEMENTS

N
W E
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LEGEND

- PUBLIC SCHOOL LOCATIONS
- HISTORIC NATIONAL REGISTER STRUCTURES
- NATURAL HERITAGE OCCURANCE SITES
- PROPOSED GRADE SEPARATION
- EXISTING GRADE SEPARATION
- 2 LANE PROPOSED
- 4 LANE DIVIDED PROPOSED
- 4 LANE DIVIDED WIDENING
- RIVERS/STREAMS
- WETLAND STREAMS
- WETLANDS
- STUDY AREA
- NORLINA TOWN LIMITS

SR 1230 (Bessie Hicks Road)
SR 1229 (Heaven Street)
SR 1228 (Hawk Road)
SR 1228 (Hawk Road)
SR 1319 (Weldon Road)
SR 1232 (White Road)
SR 1231 (Ohne Road)
SR 1228 (Walker Street)
SR 1210 (St. Tammany Road)
SR 1320 (Plains Road)
Hyco St.
Division Street
SR 1305 (Warren Plains Road)
SR 1107 (Ridgeway-Warrenton Road)
Bypass
158 B
1
158
401

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH

IN COOPERATION WITH
US DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 800 1,600 3,200 4,800
Feet

MAP DATE: SEPTEMBER 2004

III. Population, Land Use, and Traffic

In order to fulfill the objectives of an adequate thirty-year thoroughfare plan, reliable forecasts of future travel patterns must be achieved. Such forecasts depend on careful analysis of the following items: historic and potential population changes; significant economic trends; character and intensity of land development; and the ability of the existing transportation system to meet existing and future travel demand. Secondary items that influence forecasts include the effects of legal controls such as zoning ordinances and subdivision regulations, availability of public utilities and transportation facilities, and topographic and other physical features of the urban area.

Population

Since the volume of traffic on a roadway is related to the size and distribution of the population that it serves, population data is used to aid in the development of the thoroughfare plan. Future population estimates typically rely on the observance of past population trends and counts. A more in-depth discussion of the population data used for this study is later in this chapter.

Land Use

Land use refers to the physical patterns of activities and functions within an area. The traffic patterns on a particular road are related to the land uses adjacent to that facility and the intensity of land use. For example, a shopping center generates larger traffic volumes than a residential area. The spatial distribution of varying land uses is the predominant determinant of when, where, and why congestion occurs. The attraction between different land uses and their association with travel varies with the size, type, intensity, and spatial separation of each land use. When dealing with transportation planning, land use is divided into the following classifications:

- Residential – Land is devoted to the housing of people, with the exception of hotels and motels.

- Commercial – Land is devoted to retail trade including consumer and business services and their offices; this may be further stratified into retail and special retail classifications. Special retail would include high-traffic establishments, such as fast-food restaurants and service stations; all other commercial establishments would be considered retail.

- Industrial – Land is devoted to the manufacturing, storage, warehousing, and transportation of products.

- Public – Land is devoted to social, religious, educational, cultural, and political activities; this would include the office and service employment establishments.

The town of Norlina has most of their commercial development within the town limits and south of the town limits. The industrial development is spread throughout the study area. Residential and public development is spread throughout the study area, with the heaviest densities inside the municipal limits.

Traffic Model

In thoroughfare plan studies a traffic model is developed to help analyze the current and future roadway networks. The purpose of the traffic model is to replicate the conditions on the street system by taking into account the population and land use of an area. In order to develop an efficient thoroughfare plan for the town of Norlina it was necessary to develop and calibrate a traffic model of the town. To develop a traffic model a study area is defined and socioeconomic data is projected to the design year. Once the socioeconomic data has been projected the model may be used to evaluate various street system problems and alternate solutions to the problems. The traffic model used in this study was not a computer model; all calculations were hand allocated.

The Study Area

The study area of Norlina consists of the town limits and some additional outlying areas. This area was divided into 10 traffic analysis zones for data collection and aggregation. The study area and zones are shown in **Figure 4**. The zones reflect similar land use throughout the study area. The data for the dwelling units and employment for 2003 was collected from windshield surveys. The projection of socioeconomic data to the future year of 2035 was based on past trends, cooperatively developed with the town council.

The Base Year Network

The purpose of the traffic model is to replicate the conditions on the town's street system. Therefore it is necessary to represent the existing street system in the model. There is a balance between having too many streets on the model to allow it to be calibrated and not having enough streets to realistically duplicate existing conditions. Generally, all the major arterials and some of the major land access or collector streets need to be represented.

Data Requirements

In order to produce an adequate traffic model of the study area, two additional types of data are required. First, traffic counts on routes used in the model provide a basis for calibrating the model. These traffic counts show a snapshot of traffic conditions in the study area. Second, socioeconomic data (housing counts and employment estimates) are necessary in order to generate traffic for the model.

- **Traffic Counts:** The model must be calibrated against existing conditions in the study area. In order to calibrate the model, the 2003 Annual Average Daily Traffic (AADT) counts available from the Traffic Survey Unit were used. Also, volumes on all routes crossing the study boundary were taken into consideration. These counts show how much traffic is entering and exiting the study area.

- **Socioeconomic Data:** The required data consists of housing and employment counts. The housing counts are used in the model as the generator of trips and employment is used as the attractor of trips. The Transportation Planning Branch staff conducted a windshield survey in May 2003, to collect housing and employment data. The employment data that was collected was broken down by Standard Industrial Code (SIC) classification and grouped into five categories: industry, special retail, retail, office and services. The number of employees of each business was based on data from the Employment Securities Commission and estimated by the Transportation Planning Branch when no estimates were available.

- **Commercial Vehicles:** Commercial vehicles have somewhat different trip generation characteristics than do privately owned vehicles. Due to the small size of this study, commercial vehicle data was not collected.

Trip Generation

Trip generation is the process by which external station volumes, housing data, and employment data are used to generate traffic volumes that duplicate the traffic volumes on the street network. The technical definition of a trip is slightly different than the definition of a trip used by the general public. Technically a trip only has one origin and one destination (i.e., home to doctor's office) while the layman will often group, or chain, several short trips together as one longer trip.

Traffic inside the study area has three major components: through trips, external-internal trips, and internal trips. Through trips are produced outside the study area and pass through enroute to a destination outside the study area. Internal-external trips have one end of the trip outside of the study area. Internal trips have both their origin and destination inside the study area.

- **Through Trips:** The through trip table for this study was developed based on *Technical Report 3* (Synthesized Through Trip Table for Small Urban Areas By Dr. David G. Modlin, Jr.). Once these volumes were developed the Fratar balancing method was then used to balance the trip interchanges so that the total number of through trips at each external station is consistent with the total number of through trips at every other station. Generally five iterations are sufficient to balance the estimate between external zones.

- **External – Internal Trips:** The external-internal trip volume was determined by subtracting the through trip volume at each station from the total traffic volume at that station.

- **Internal Trip Distribution:** The internal trip volume was determined by multiplying the total trips by zone attractiveness. The internal trips were distributed zone to zone based on percent attractiveness. The Gravity Model was not used in this model.

Model Calibration

The purpose of a traffic model is to predict the traffic on a street system at some future point in time; however, if the model is not accurate, it is useless for this purpose. Therefore the model must duplicate the existing traffic pattern. The actual calibration of the model is an iterative process in which incremental changes are made either in the trip generation, trip distribution, or the street network. The purpose of each change is to allow the model to more accurately reflect the real world conditions upon which it is based. Only when the model can adequately reflect the existing traffic pattern should it be used to predict traffic in the future. The model was calibrated to 2003 AADT volumes.

- **Accuracy Checks:** There are two checks made on the model. The first is to follow trips through all the steps involved in the model. The purpose of this check is to ensure that no trips have been accidentally added to or subtracted from the model, and that no trips have been counted twice. The second check for the model is to match the traffic volumes on the links in the model with the AADT at the same locations. The 'link counts' can be used to find particular places in the network where there are problems. Comparing the link counts with the ground counts for the links in this model did not reveal any significant problems with the model.

Data Projections to the Design Year

In order to make use of the model the base year data must be modified to reflect assumed conditions in the design year. These projections were used to produce trip productions and attractions in the same manner as the base year.

The first step in the population projection process is the gathering of past population data. **Table 1** gives the historic trends for Warren County, Smith Creek Township, and Norlina.

Area	Year	Population	Total Housing Units	Persons/Dwelling Unit
Warren County	1970	15,340	4,855	3.16
	1980	16,232	7,010	2.32
	1990	17,265	8,714	1.98
	2000	19,972	10,548	1.89
	2001	19,975	-	-
	2002	20,256	-	-
	2003	20,537	-	-
Smith Creek Township	1970	2,020	-	-
	1980	2,081	789	2.64
	1990	2,266	952	2.38
	2000	2,198	1,039	2.12
	2001	-	-	-
	2002	-	-	-
	2003	-	-	-
Norlina	1970	969	-	-
	1980	901	384	2.35
	1990	996	456	2.18
	2000	1,107	534	2.07
	2001	1,106	-	-
	2002	-	-	-
	2003	-	-	-

Table 1: Past Population Data for the Study Area

Data for the 2003 population of Norlina was unavailable when the projections were prepared. At that time, the most recent population for the town of Norlina was 1,106 in 2001. Using a growth rate of 0.40% (which is outlined below), the 2003 population of Norlina was estimated to be 1,120. A 2003 windshield survey was done to determine the number of dwelling units outside the town limits, but inside the study area. 368 dwelling units were counted outside the corporate limits, but inside the study area. 546 dwelling units were counted inside the corporate limits. The persons per dwelling unit (persons/du) of the population inside the town of Norlina was estimated at 2.05 for 2003 (1120/546 = 2.05). Since the Smith Creek Township year 2000 persons/du was 2.12, an estimate of 2.10 was used for the year 2003. Multiplying 2.10 by 368 gives us a population of 772, which is the estimate of the number of people outside of the corporate limits but inside the study area.

Therefore:

772	2003 Population outside Corporate Limits
+ 1,120	2003 Population of Norlina
=====	
1,892	2003 Total Study Area Population

Dividing the study area population by the number of dwelling units in the study area gives us 2.07 persons/du for the 2003 study area. (1,892/(368+546) = 2.07)

Before beginning to project the base year employment and population data, which was collected by the Transportation Planning Branch staff, a target

population for the design year 2035 was developed. Much like determining an interest rate, a population growth rate had to be determined. To do this, historic population data was gathered from the NC State Data Center for Warren County, Smith Creek Township, and the town of Norlina from 1970 to 2000 (See **Table 1** above).

Using the known data a growth rate was determined with the formula $F=P(1+r)^N$ where:

F = future population
P = present population
r = rate of growth
N = number of years

Warren County showed a growth rate of 0.88% per year from 1970 to 2000 while Smith Creek Township showed a growth rate of 0.30%. Over the same time period the town of Norlina had an average growth rate of 0.004% per year. Even though Norlina has a low growth rate, there are signs of development occurring and industry increasing. Therefore a growth rate of 0.50% was used to give a 2035 study area population of 2,219.

The study area population data obtained above was then converted to future housing. From the extrapolation of past trends, 2.00 persons/du unit was estimated for 2035. Using these numbers, it is estimated that there will be 1,110 dwelling units by the design year 2035. Subtracting the design year dwelling units from the base year dwelling units will give an estimated dwelling unit growth of 196 (1,110-914 = 196).

Data for each employer in the Norlina study area was collected. Employment figures for the 2003 study area were determined to be 818 jobs. This total was based on employment data obtained from the Employment Security Commission and Transportation Planning Branch estimates when no data was available. Shown below are the numbers and percentages of jobs divided into categories based on the SIC numbers:

SIC 1-49	Industry	164 Jobs	20%
SIC 50-54,56,57,59	Retail	153 Jobs	19%
SIC 55, 58	Special Retail	40 Jobs	5%
SIC 70-76, 78-89, 99	Service	432 Jobs	53%
SIC 60-67, 91-97	Office	29 Jobs	4%

To determine jobs in this area for the future, a ratio was taken with the present number of jobs over the 2003 population of the study area.

2003 employment / 2003 population = 818/1,892 = 0.432

For the purposes of this report, and with the slow job growth trends in the area, we will assume that the employee to population ratio will remain the same as the population of the study area increases. Therefore:

2,219 x 0.432 = 959 ➔ 2035 employment

An increase of 141 jobs are projected to occur by the year 2035 (959 - 818 = 141). It was not assumed that the categories remained constant. Increases were formulated based on discussions with local officials. **Table 2** displays the employment projections that were made for 2035.

	%	2003 Estimated Employment	2035 Projected Employment	Increase
Industrial	20%	164	192	28
Retail	19%	153	179	58
Special Retail	5%	40	47	40
Service	53%	432	506	10
Office	4%	29	34	5
Totals	**100%**	**818**	**959**	**141**

Table 2: Employment Projections

The study area results are shown in **Table 3**. From this table, we find that 196 dwelling units are projected to be added by 2035, and 141 jobs are projected to be added before 2035. The Transportation Planning Branch and the town leaders distributed the increases in socioeconomic data to the zones they anticipated employment growth. Those projections were added to the 2003 data. Employment projections throughout the study area indicated steady growth.

	Population	Persons Per Dwelling Unit	Dwelling Units	Employment
2003	1892	2.07	914	818
2035	2219	2	1110	959

Table 3: Study Area Population and Employment Results

External and Through Trips

For the design year, external and through trips were projected from the base year using a linear projection of the past growth rate at each external station. External Station Data can be found in **Table 4**.

External Station	Base Year 2003			Future Year 2035		
	Total ADT	Thru Trip Ends	Ext-Int Trips	Total ADT	Thru Trip Ends	Ext-Int Trips
1	300	84	216	450	172	278
2	3100	2638	462	6000	3484	2516
3	900	176	724	1300	358	942
4	550	462	88	760	682	78
5	3000	2004	996	4200	2720	1480
6	3000	1390	1610	5900	1900	4000
7	5400	3136	2264	10600	4730	6270
8	1000	296	704	2000	506	1494
9	6400	5398	1002	18900	7930	11070
10	1400	408	992	2700	558	2142

Table 4: External Station Travel

Existing Transportation System

An important stage in the development of a thoroughfare plan is the analysis of the existing roadway system and its ability to serve the area's travel desires. Emphasis is placed not only on detecting the existing deficiencies, but also on understanding the causes of these deficiencies. Capacity deficiencies may result from problems with inadequate pavement width, intersection geometry, or intersection controls. System deficiencies may result from system problems such as the need to construct missing travel links, bypass routes, loop facilities, or additional radial routes.

An analysis of the roadway system looks at both current and future travel patterns and identifies existing and anticipated deficiencies. This is usually accomplished through a traffic crash analysis, roadway capacity deficiency analysis, and a system deficiency analysis. This information is used to analyze factors that will impact the future system, including population growth, economic development potential, and land use trends.

Traffic Crash Analysis

Traffic crashes are often used as an indicator for locating congestion problems. While often the result of drivers or vehicle performance, crashes may also be a result of the physical characteristics of the roadway. Roadway conditions and obstructions, traffic conditions, and weather may all lead to a crash. While some crashes are the fault of the driver, others may be prevented with physical design changes or traffic control changes such as the installations of stop signs or traffic signals.

Crash data for the period of January 2000 to December 2002 was obtained from the Traffic Engineering Branch of NCDOT and was studied as part of the development for this report. The analysis considered both crash frequency and severity. Crash frequency is the total number of reported collisions, while crash severity is the crash rate based upon injuries and property damage incurred.

These two factors helped to determine the high crash locations within the town that are summarized in **Table 5**.

Locations	Angle	Rear End	Ran Off Road	Left Turn	Right Turn	Other	Total	Severity
US 158/SR 1305	5	1	-	3	-	1	10	3.47
US 158/US 158	2	1	1	1	-	1	6	3.11

Table 5: Locations with Five or More Crashes in a Three Year Period

To request a more detailed analysis for any of the locations listed in **Table 5**, or other intersections of concern, the town should contact the Division Traffic Engineer. Contact information for the Division Traffic Engineer is included in **Appendix E**.

Roadway Capacity Deficiencies

Capacity deficiencies occur wherever the travel demand volume of a roadway is close to or more than the capacity of that roadway. Travel demand is the total number of vehicles that use a roadway on a daily basis. The existing travel demand volumes for Norlina are based upon traffic count data taken annually by the NCDOT Traffic Survey Unit and are shown in **Figure 5** for the year 2003. The projected 2035 travel demand volumes from the traffic model are shown in **Figure 6**. These are the projected traffic volumes without any improvements to the roadways.

Capacity is the maximum number of vehicles that can pass over a given section of roadway during a given time period under prevailing roadway and traffic conditions. Many factors contribute to the capacity of a roadway, including:

- Geometry of the road, including number of lanes, horizontal and vertical alignment, and proximity of perceived obstructions to safe travel along the road;
- Typical users of the road, such as commuters, recreational travelers, and truck traffic;
- Access control, including streets and driveways, or lack thereof, along the roadway;
- Development of the road, including residential, commercial, and industrial developments;
- Number of traffic signals along the route;
- Peaking characteristics of the traffic on the road;
- Characteristics of side-roads feeding into the road; and
- Directional split of traffic or the percentages of vehicles traveling in each direction along a road at any given time.

The relationship of travel demand to roadway capacity determines the level-of-service (LOS) of a roadway. Six distinct levels-of-service are possible, with letter

designations ranging from LOS A, which represents the best operating conditions, to LOS F, which represents the worst operating conditions. LOS D indicates "practical capacity" of a roadway, or the capacity at which the public begins to express dissatisfaction. The six levels of service are described below and illustrated in **Figure 7**.

- **LOS A**: Describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 528 ft, or 26 car lengths.
- **LOS B**: Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 330 ft, or 18 car lengths.
- **LOS C**: Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacing is in the range of 220 ft, or 11 car lengths.
- **LOS D**: Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 165 ft, or nine car lengths.
- **LOS E**: Describes operation at capacity. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This can establish a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing. Vehicles are spaced at approximately six car lengths, leaving little room to maneuver.
- **LOS F**: Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.

Design requirements for roadways vary according to the desired capacity and level-of-service. Recommended improvements and overall design of the thoroughfare plan were based upon achieving a minimum LOS D on existing facilities and a LOS C on new facilities.

2003 Traffic Capacity Analysis

The comparison of the 2003 travel demand for the major roadways in Norlina to the current practical capacities for these roadways did not identify any deficiencies in the town of Norlina.

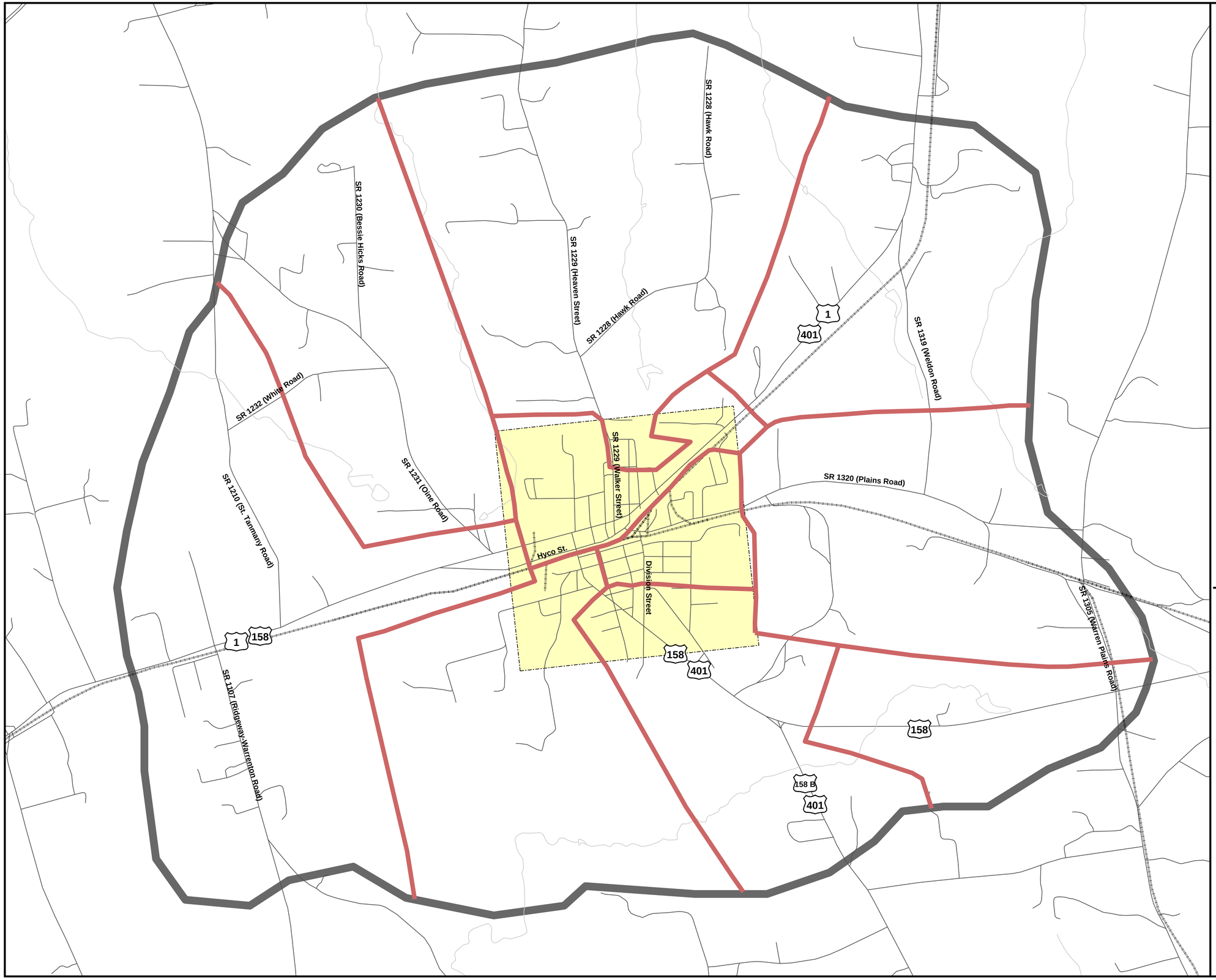
2035 Traffic Capacity Analysis

The capacity deficiency analysis for the 2035 design year examined the existing street system and determined that several roadways will exceed capacity if improvements are not made. The roadways that will exceed capacity by the design year include portions of US 1 and US 158. These capacity deficiencies are shown in **Figure 6**.

NCDOT TPB
TRANSPORTATION PLANNING BRANCH

FIGURE 4

STUDY AREA BOUNDARY



LEGEND

- TRAFFIC ANALYSIS ZONES
- STUDY AREA
- NORLINA TOWN LIMITS

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH

IN COOPERATION WITH
US DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 800 1,600 3,200 4,800 Feet

MAP DATE: SEPTEMBER 2004

NCDOT TPB
TRANSPORTATION PLANNING BRANCH

FIGURE 5

2003 AADT

N
W E
S

LEGEND

- STUDY AREA
- NORLINA TOWN LIMITS
- 00000 2003 AVERAGE ANNUAL DAILY TRAFFIC

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH

IN COOPERATION WITH
US DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 800 1,600 3,200 4,800
Feet

MAP DATE: SEPTEMBER 2004

NCDOT TPB
TRANSPORTATION PLANNING BRANCH

FIGURE 6

PROJECTED 2035 ADT

N
W E
S

LEGEND

- AT OR OVER CAPACITY (V/C >= 1.0)
- STUDY AREA
- NORLINA TOWN LIMITS
- 00000 PROJECTED 2035 AVERAGE DAILY TRAFFIC

SR 1230 (Bessie Hicks Road)
SR 1229 (Heaven Street)
SR 1228 (Hawk Road)
SR 1228 (Hawk Road)
SR 1319 (Weldon Road)
SR 1232 (White Road)
SR 1210 (St. Tammany Road)
SR 1231 (Olne Road)
SR 1229 (Walker Street)
SR 1320 (Plains Road)
Hyco St.
Division Street
SR 1305 (Warren Plains Road)
SR 1107 (Ridgeway-Warrenton Road)

9500
18000
25000
23000
24000
19000
21000
15000
10000
11000

1
401
158
158 B

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

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TRANSPORTATION PLANNING BRANCH

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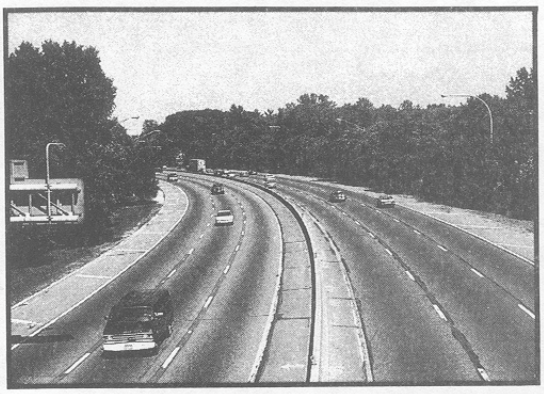
US DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

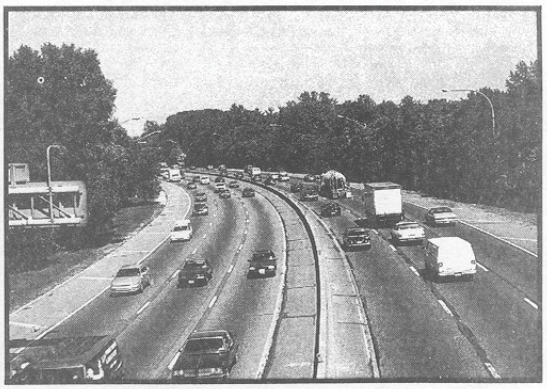
0 800 1,600 3,200 4,800
Feet

MAP DATE: SEPTEMBER 2004

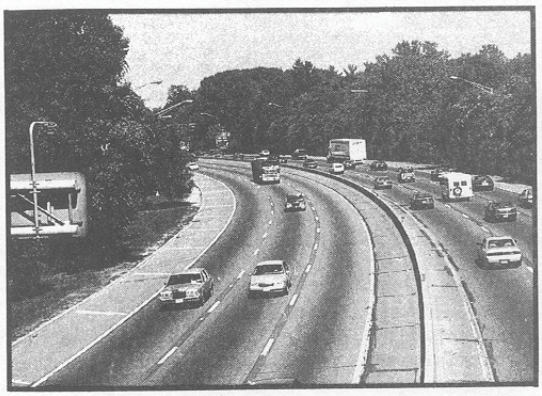
Source: 1994 Highway Capacity Manual



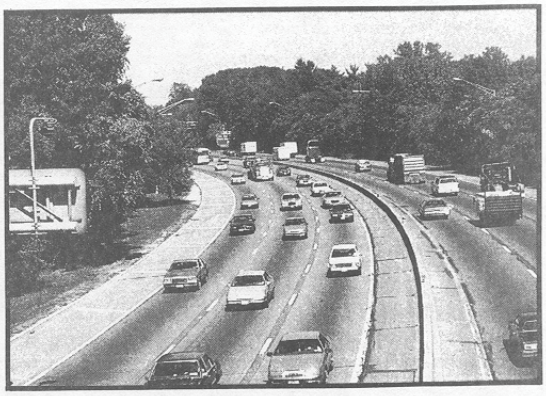
LOS A.



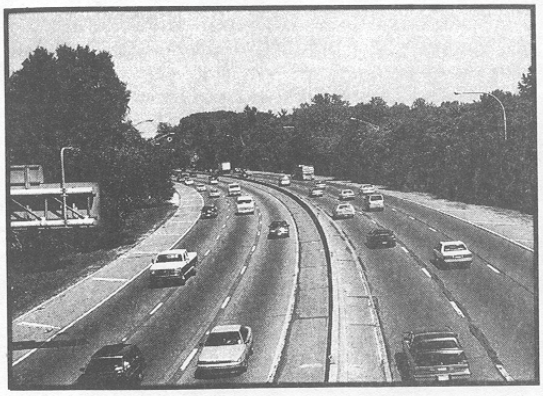
LOS D.



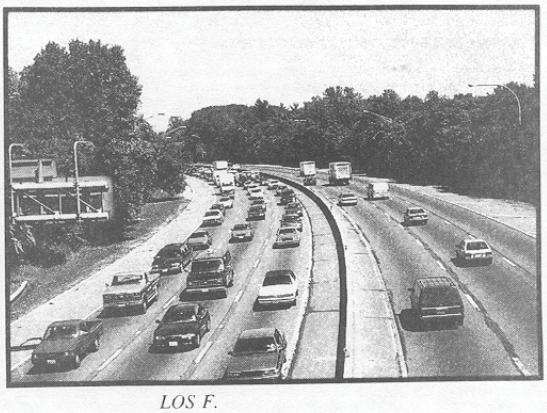
LOS B.



LOS E.



LOS C.



LOS F.

Figure 7: Levels of Service

IV. Environmental Screening

In recent years, the environmental considerations associated with transportation construction have come to the forefront of the planning process. Section 102 of the National Environmental Policy Act (NEPA) requires the completion of an Environmental Impact Statement (EIS) for projects that have a significant impact on the environment. The EIS includes impacts on wetlands, wildlife, water quality, historic properties, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS would, consideration for many of these factors was incorporated into the development of the thoroughfare plan. These factors were also incorporated into the recommended improvements. Environmental features found in the area are shown in **Figure 8**.

Wetlands

Wetlands are those lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by storing and slowly releasing floodwaters. Wetlands help maintain the quality of water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations by providing an important habitat for approximately one-third of the plant and animal species that are federally listed as threatened or endangered. The National Wetland Inventory showed several wetlands throughout the study area. Wetland impacts have been avoided or minimized to the greatest extent possible while preserving the integrity of the thoroughfare plan.

Threatened and Endangered Species

The Threatened and Endangered Species Act of 1973 allows the U.S. Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a transportation project on endangered animal and plant species, as well as critical wildlife habitats. Locating any rare species that exist within the study area during this early planning stage will help to avoid or minimize impacts.

A preliminary review of the Federally Listed Threatened and Endangered Species in the study area was completed to determine what effects, if any, the recommended improvements may have on wildlife. Mapping from the N.C. Department of Environment and Natural Resources revealed occurrences of threatened or endangered plant and/or animal species in the town of Norlina. No threatened or endangered species are anticipated to be adversely impacted by any of the thoroughfare plan recommendations. However, a detailed field investigation is recommended prior to construction of any highway project in this area.

Historic Sites

Section 106 of the National Historic Preservation Act requires the Department of Transportation to identify historic properties listed in, as well as eligible for, the National Register of Historic Places (NRHP). The NCDOT must consider the impacts of transportation projects on these properties and consult with the Federal Advisory Council on Historic Preservation.

N.C. General Statute 121-12(a) requires the NCDOT to identify historic properties listed on the National Register, but not necessarily those that are eligible to be listed. The NCDOT must consider the impacts and consult with the State Historic Preservation Office (SHPO), but is not bound by their recommendations.

The location of historic sites within the study area was investigated to determine any possible impacts resulting from the recommended improvements. This investigation identified one historic property along Ridgeway Warrenton Road (SR 1107). This property will not be impacted by any of the recommended improvements.

Educational Facilities

The location of educational facilities in the study area was considered during the development of the thoroughfare plan. The implementation of the thoroughfare plan should result in positive effects on educational facilities in the study area by improving the safety and capacity of the roadways around educational facilities, and avoiding existing schools.

NCDOT TPB
TRANSPORTATION PLANNING BRANCH

FIGURE 8

ENVIRONMENTAL DATA

N
W E
S

LEGEND

- PUBLIC SCHOOL LOCATIONS
- HISTORIC NATIONAL REGISTER STRUCTURES
- NATURAL HERITAGE OCCURANCE SITES
- RIVERS/STREAMS
- WETLAND STREAMS
- WETLANDS
- STUDY AREA
- NORLINA TOWN LIMITS

TOWN OF
NORLINA
WARREN COUNTY
NORTH CAROLINA

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FEDERAL HIGHWAY ADMINISTRATION

0 800 1,600 3,200 4,800
Feet

MAP DATE: SEPTEMBER 2004

V. Public Involvement

Overview

Since the passage of the federal Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the emphasis on public involvement in transportation has taken on a new role. Although public participation has been an element of long range transportation planning in the past, these regulations call for a much more proactive approach. The NCDOT's Transportation Planning Branch has a long history of making public involvement a key element in the development of any long range transportation plan, no matter the size of the town. This chapter is designed to provide an overview of the public involvement elements implemented into the development of the thoroughfare plan for the town of Norlina.

Study Initiation

The Norlina Thoroughfare Plan study was requested on March 3, 2003 by way of a letter from the town of Norlina. The Transportation Planning Branch met with the town officials in March 2003 to identify the primary transportation concerns and to define the scope of the study.

Public Meetings

Throughout the course of this study the Transportation Planning Branch attended three Norlina Town Council meetings. At each of these meetings the staff gave an update on the progress of the study and received the town's input on the study area boundary, population and employment projections, and proposed recommendations.

Public Hearing

A public hearing was held at Norlina's Town Hall on November 1, 2004. The purpose of this meeting was to discuss the plan recommendations and to solicit public input. One citizen voiced his concerns about the thoroughfare plan at this meeting. His comments included the following:

- He was concerned with the location of the US 158 Bypass. He thought that widening the route through town would be a better option.
- He was concerned over the possibility of US 158 taking customers away from existing businesses near and inside the town limits.

The thoroughfare plan was unanimously adopted by the Norlina Town Council on November 1, 2004.

VII. Conclusion

Norlina is a growing community that will require improvements to its transportation system over the next thirty years. It is the responsibility of the town to take the initiative for the implementation of the thoroughfare plan. It is imperative that the local area aggressively pursues funding for desired projects. Questions regarding funding, projects, planning, and modes of transportation should be addressed to the appropriate branch within NCDOT. **Appendix E** includes contact information for many of these branches.

Appendix A: Thoroughfare Planning Principles

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permits travel from origins to destinations with directness, ease, and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, such as the town of Norlina, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area and they accommodate traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets
This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses as shown in **Figure A-1**.

Radial streets provide for traffic movement between points located on the outskirts of the town and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of crosstown streets that form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the area's border. It also allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a business or pedestrian shopping area.

Loop system streets move traffic between suburban areas of the town. Although a loop may completely encircle the town, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve central areas. There may be one or more loops, depending on the size of the urban area. They are generally spaced one-half mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the town street system by removing traffic that has no desire to be in the town. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the town. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Rural Classification

The facilities outside the urban thoroughfare planning boundaries make up the rural system. There are four major systems: principal arterials, minor arterials, major and minor collectors, and local roads.

Rural Principal Arterial System

This system is a connected network of continuous routes that serve corridor movements having substantial statewide or interstate travel characteristics. This will be shown by both the trip lengths and the travel densities. The principal arterial system should serve all urban areas of over 50,000 population and most of those with a population greater than 5,000. The Interstate system constitutes a significant portion of the principal arterial system.

Rural Minor Arterial System

This system forms a network that links cities, larger towns, and other traffic generators such as large resorts. The minor arterial system generally serves intrastate and intercounty travels and travel corridors with trip lengths and travel densities somewhat less than the principal arterial system.

Rural Collector Road System

The rural collector routes generally serve intracounty travel. These routes serve travel whose distances are shorter than on the arterial routes. The rural collector road system is subclassified into major and minor collector roads.

- **Major Collector Roads** - These routes provide service to the larger towns not directly served by the higher systems and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, significant mining and agricultural areas, etc. Major collector roads also link these places to routes of higher classification and serve the more important intracounty travel corridors.

- **Minor Collector Roads** - These routes collect traffic from local roads and bring all developed areas within a reasonable distance of a major collector road. They also provide service to the remaining smaller communities and link the locally important traffic generators with the rural outskirts.

Rural Local Road System

The local roads are all roads that are not on a higher system. Local residential subdivision streets and residential collector streets are elements of the local road system. Local residential streets are either cul-de-sacs, loop streets less than 2,500 feet in length, or streets less 1 mile in length. They do not connect thoroughfares or serve major traffic generators and do not collect traffic from more than one hundred dwelling units. Residential collectors serve as the connecting street system between local residential streets and the thoroughfare system.

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system that will meet existing and future travel desires within the urban area. The primary aim of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with the changing traffic patterns. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and it helps eliminate unnecessary improvements, so needless expense can be averted. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained, requiring a minimum amount of land for street purposes. In addition to providing for traffic needs the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial and industrial development affect major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

- To provide for the orderly development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of the street system with private action;
- To enable private interest to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;
- To reduce environmental impacts, such as air pollution, resulting from transportation, and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency through system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry more vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined by the maximum number of vehicles that can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions. The physical features of the roadway, nature of traffic, and weather affect capacity. Physical ways to improve vehicular capacity include:

- **Street widening** - Widening of a street from two to four lanes more than doubles the capacity of the street by providing additional maneuverability for traffic.
- **Intersection improvements** - Increasing the turning radii, adding exclusive turn lanes, and channeling movements can improve the capacity of an existing intersection.
- **Improving vertical and horizontal alignment** - Reduces the congestion caused by slow moving vehicles.
- **Eliminating roadside obstacles** - Reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

- **Control of access** - A roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.
- **Parking removal** - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.
- **One-way operation** - The capacity of a street can sometimes be increased 20 - 50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.
- **Reversible lane** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.
- **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

- **Carpools** - Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.
- **Alternate mode** - Encourage the use of transit and bicycle modes.
- **Work hours** - Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. This will spread peak travel over a longer time period and thus reduce peak hour demand.
- **Land use** - Plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means for altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost to the user. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice thoroughfare planning is done for established urban area and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.
2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.
3. The plan should conform to and provide for the land development plan for the area.
4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.
5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

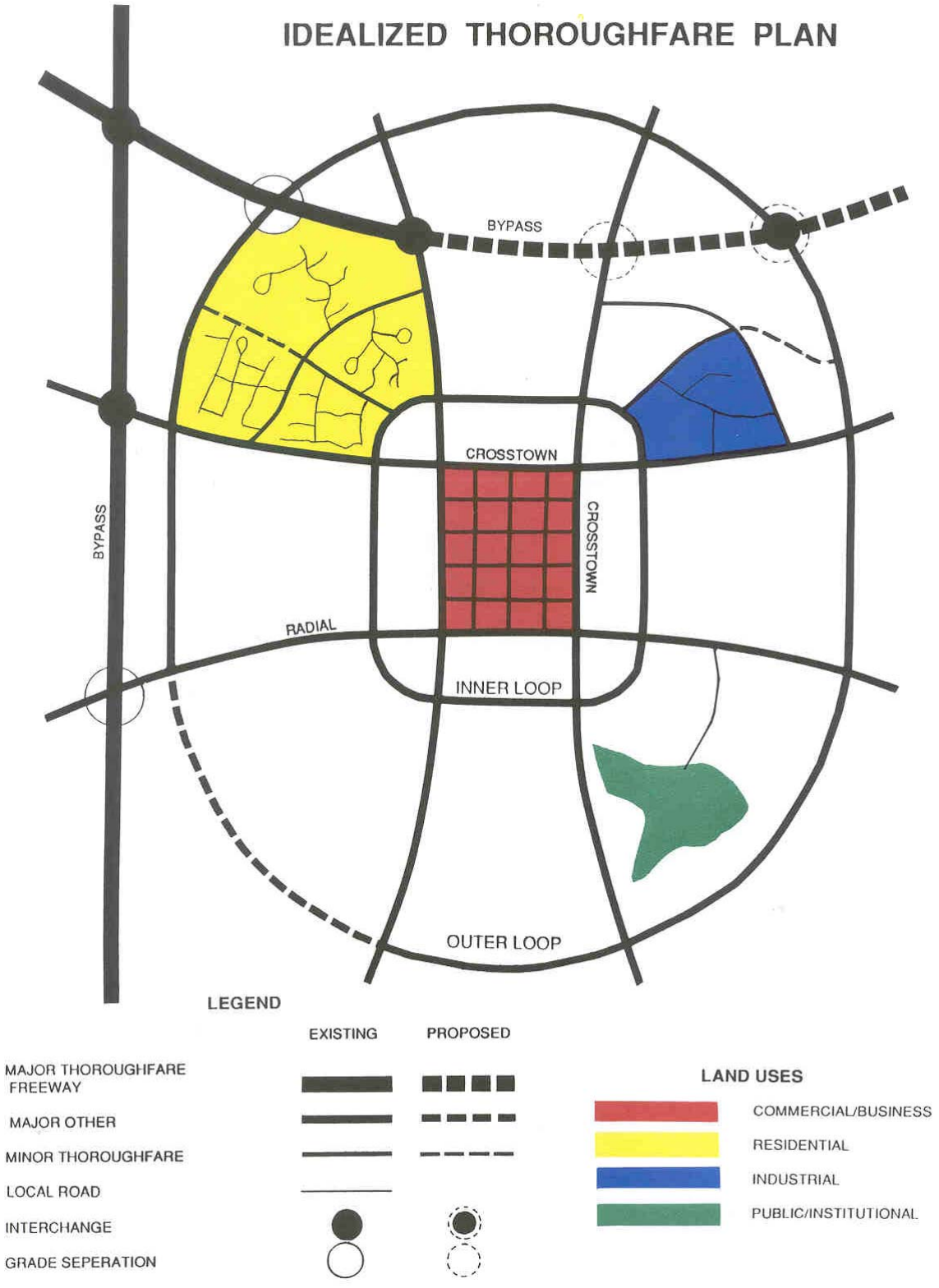


Figure A-1: Idealized Thoroughfare Plan

Appendix B: Thoroughfare Street Tabulation and Recommendations

This appendix includes a detailed tabulation of all streets identified as elements of the Norlina Thoroughfare Plan. The table includes a description of the roads by sections, as well as the length, cross section, and right-of-way for each section. Also included is the existing and projected average daily traffic volumes, roadway capacity, and the recommended ultimate lane configuration. Due to space constraints, these recommended cross sections are given in the form of an alphabetic code. A detailed description of each of these codes and an illustrative figure for each can be found in **Appendix C**.

The following index of terms may be helpful in interpreting the table:

ECL – Eastern Corporate Limits
NCL – Northern Corporate Limits
SCL – Southern Corporate Limits
WCL – Western Corporate Limits
EPB – Eastern Planning Boundary
NPB – Northern Planning Boundary
SPB – Southern Planning Boundary
WPB – Western Planning Boundary
SR - State Road
N/A - Not Available
RDWY – Roadway
ROW – Right-of-way

FACILITY & SECTION	DIST (MI)	EXISTING CONDITIONS RDWY (FT)	ROW (FT)	NO. OF LANES	CAPACITY (vpd)	NO BUILD ADT 2003 ADT	2030 ADT	RECOMMENDATIONS CROSS SECTION	CAPACITY (VPD)	2030 ADT
US 1										
WPB - SR 1210	0.64	23	100	2	9,900	6,600	19,000	F	35,000	19,000
SR 1210 - WCL	0.89	23	100	2	9,900	6,600	23,000	Adequate	Adequate	9,500
WCL - Terrell Street	0.38	22	60	2	9,000	7,100	25,000	Adequate	Adequate	11,000
Terrell Street - Hyco Street	0.24	34	60	2	9,800	7,100	18,000	Adequate	Adequate	19,000
Hyco Street - Rooker Street	0.15	21	60	2	8,700	4,100	9,500	Adequate	Adequate	9,500
Rooker Street - ECL	0.48	21	100	2	8,700	2,200	9,500	Adequate	Adequate	9,500
ECL - SR 1319	0.98	21	100	2	8,100	2,200	6,000	Adequate	Adequate	6,000
SR 1319 - NPB	0.49	21	100	2	9,100	2,200	6,000	Adequate	Adequate	6,000
US 158										
WPB - Terrell Street	[common to US 1]									
Terrell Street - SCL	0.73	21	60	2	8,700	8,500	24,000	Adequate	Adequate	11,000
SCL - US 158 Business	0.46	22	60	2	7,300	9,000	21,000	Adequate	Adequate	15,000
US 158 Business - Warren County High School	0.70	21	60	2	7,000	4,900	15,000	F	25,000	15,000
Warren County High School - SR 1305	0.70	21	60	2	7,000	4,900	10,000	F	35,000	9,500
SR 1305 - EPB	0.16	20	60	2	6,600	3,000	10,000	F	35,000	9,500
US 158 Business										
US 158 - SPB	0.65	22	80	2	10,100	5,500	11,000	F	25,000	11,000
US 158 Bypass										
US 1 - US 158 Business	1.90	-	-	-	-	-	-	F	35,000	13,000
US 401										
NPB - ECL	[common to US 1]									
ECL - US 158	[common to US 1]									
US 158 - SPB	[common to US 158 Business]									
SR 1105 (Hyco Street)										
US 1 - WCL	0.13	19	60	2	8,600	N/A	N/A	Adequate	Adequate	N/A
WCL - US 158	0.38	18	40	2	7,700	N/A	N/A	Adequate	Adequate	N/A
US 158 - Center Street	0.14	22	40	2	10,400	N/A	N/A	Adequate	Adequate	N/A
Center Street - Warren Plains Road	0.08	58	60	2 + Parking	15,000	N/A	N/A	Adequate	Adequate	N/A
Warren Plains Road - North Street	0.07	52	50	2 + Parking	15,000	N/A	N/A	Adequate	Adequate	N/A
SR 1107 (Ridgeway-Warrenton Road)										
US 1 - SR 1143	0.54	20	60	2	9,900	1,400	2,000	Adequate	Adequate	2,000
SR 1143 - SPB	0.52	20	60	2	9,900	1,400	2,000	Adequate	Adequate	2,000
SR 1229 (Heaven Street)										
NPB - SR 1228	1.24	20	60	2	10,400	400	400	Adequate	Adequate	400
SR 1228 - NCL	0.28	20	60	2	10,400	400	1,100	Adequate	Adequate	1,100
SR 1229 (Walker Avenue)										
NCL - US 1	0.42	20	40	2	9,400	900	1,100	Adequate	Adequate	1,100
SR 1231 (Oine Road)										
NPB - SR 1232	0.74	21	60	2	10,400	1,600	2,700	Adequate	Adequate	2,700
SR 1232 - US 1	0.92	21	60	2	10,400	1,600	2,700	Adequate	Adequate	2,700
SR 1305										
NPB - SR 1322	0.23	19	60	2	8,100	1,600	N/A	Adequate	Adequate	N/A
SR 1322 - US 158	0.46	20	60	2	8,800	1,600	N/A	Adequate	Adequate	N/A
US 158 - SPB	0.17	20	60	2	8,800	1,600	N/A	Adequate	Adequate	N/A
SR 1320										
Hyco Street - ECL	[common to SR 1320 (Warren Plains Road)]									
ECL - SR 1319	0.76	17	60	2	8,200	900	1,300	Adequate	Adequate	1,300
SR 1319 - EPB	0.63	21	60	2	10,400	900	1,300	Adequate	Adequate	1,300
SR 1320 (Warren Plains Road)										
Hyco Street - Division Street	0.06	19	60	2	8,600	900	2,200	Adequate	Adequate	2,200
Division Street - ECL	0.45	20	60	2	9,400	900	2,200	Adequate	Adequate	2,200
Division Street										
SR 1320 - US 158	0.38	18	40	2	7,700	N/A	N/A	Adequate	Adequate	N/A

Table B-1: Thoroughfare Plan Street Tabulation and Recommendations

Appendix C: Typical Thoroughfare Cross Sections

Cross section requirements for roadways vary according to the capacity and level of service to be provided. Universal standards in the design of roadways are not practical. Each roadway section must be individually analyzed and its cross section determined based on the volume and type of projected traffic, existing capacity, desired level of service, and available right-of-way. The cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

On all existing and proposed roadways delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the recommended cross sections. In addition to cross section and right-of-way recommendations for improvements, **Appendix B** may recommend ultimate needed right-of-way for the following situations:

- roadways which may require widening after the current planning period,
- roadways which are borderline adequate and accelerated traffic growth could render them deficient, and
- roadways where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to grades, sight distances, degree of curve, superelevation, and other considerations for thoroughfares are given in **Appendix D**. The typical cross sections are described below.

A: Four Lanes Divided with Median - Freeway
Cross section "A" is typical for four-lane divided highways in rural areas that may have only partial or no control of access. The minimum median width for this cross section is 46 feet, but a wider median is desirable.

B: Seven Lanes - Curb & Gutter
Cross section "B" is typically not recommended for new projects. When the conditions warrant six lanes, cross section “D” should be recommended. Cross section “B” should be used only in special situations such as when widening from a five-lane section where right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section “D” is the final cross section.

C: Five Lanes - Curb & Gutter
Typical for major thoroughfares, cross section "C" is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D: Six Lanes Divided with Raised Median - Curb & Gutter
E: Four Lanes Divided with Raised Median - Curb and Gutter
Cross sections "D" and "E" are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 16-ft median is the minimum recommended for an urban boulevard-type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In certain cases, grass or landscaped medians result in greatly increased maintenance costs and an increase danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F: Four Lanes Divided - Boulevard, Grass Median
Cross section "F" is typically recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 24 ft is recommended, with 30 ft being desirable.

G: Four Lanes - Curb and Gutter
Cross section "G" is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would likely be required at major intersections. This cross section should be used only if the above criteria are met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H: Three Lanes - Curb and Gutter
In urban environments, thoroughfares that are proposed to function as one-way traffic carriers would typically require cross section “H”.

I: Two Lanes – Curb and Gutter, Parking both sides
J: Two Lanes – Curb and Gutter, Parking one side
Cross section “I” and “J” are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross-section “I” would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K: Two Lanes - Paved Shoulder
Cross section "K" is used in rural areas or for staged construction of a wider multilane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 100 ft should be required. In some instances, local ordinances may not allow the full 100 ft. In those cases, 70 ft should be

preserved with the understanding that the full 70 ft will be preserved by use of building setbacks and future street line ordinances.

L: Six Lanes Divided with Grass Median - Freeway
Cross section “L” is typical for controlled access freeways. The 46-ft grass median is the minimum desirable width, but variation from this may be permissible depending upon design considerations. Right-of-way requirements are typically 228 ft or greater, depending upon cut and fill requirements.

M: Eight Lanes Divided with Raised Median - Curb and Gutter
Also used for controlled access freeways, cross section "M" may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N: Five Lanes with Curb & Gutter, Widened Curb Lanes
O: Two Lanes/Shoulder Section
P: Four Lanes Divided with Raised Median – Curb and Gutter, Widened Curb Lanes
If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections “N”, “O” and “P” are typically used to accommodate bicycle travel.

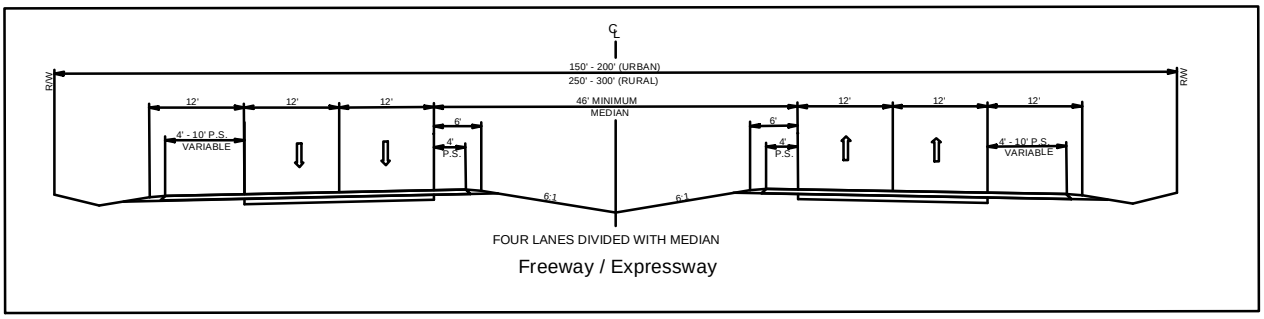
General
The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-way shown for each typical cross section is the minimum amount required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

Appendix C

TYPICAL HIGHWAY CROSS SECTIONS

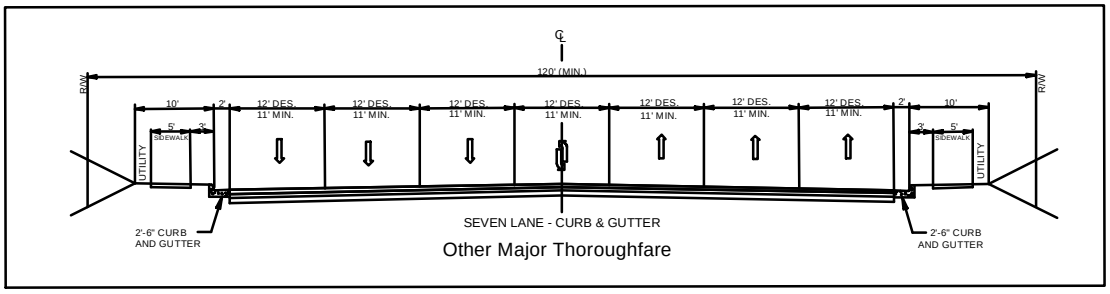
A



FOUR LANES DIVIDED WITH MEDIAN

Freeway / Expressway

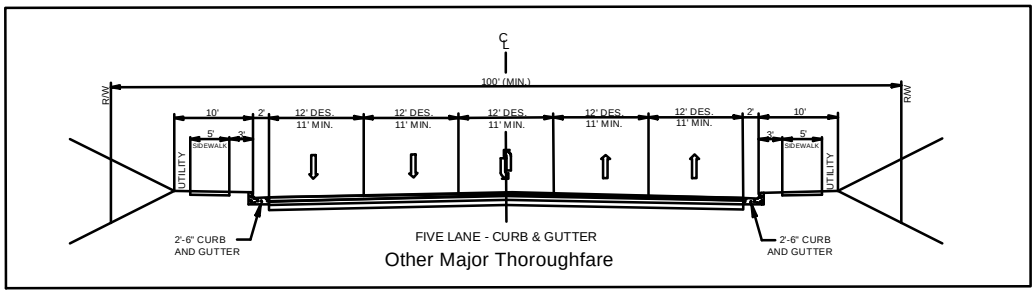
B



SEVEN LANE - CURB & GUTTER

Other Major Thoroughfare

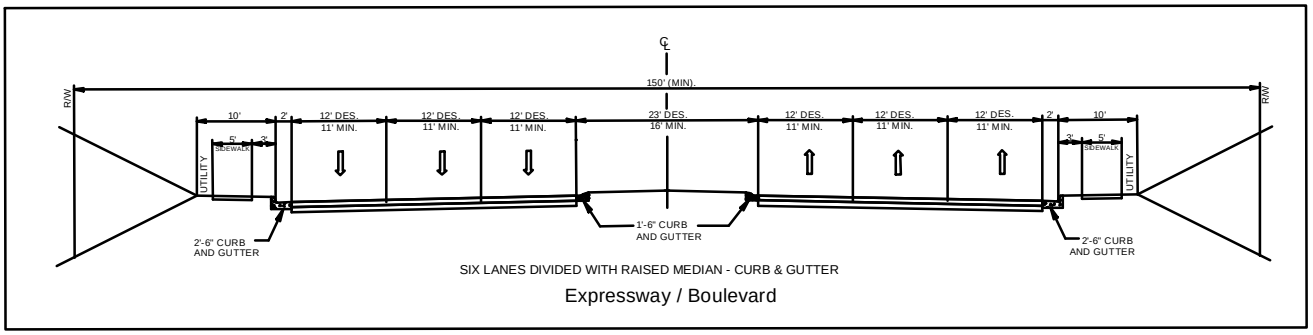
C



FIVE LANE - CURB & GUTTER

Other Major Thoroughfare

D



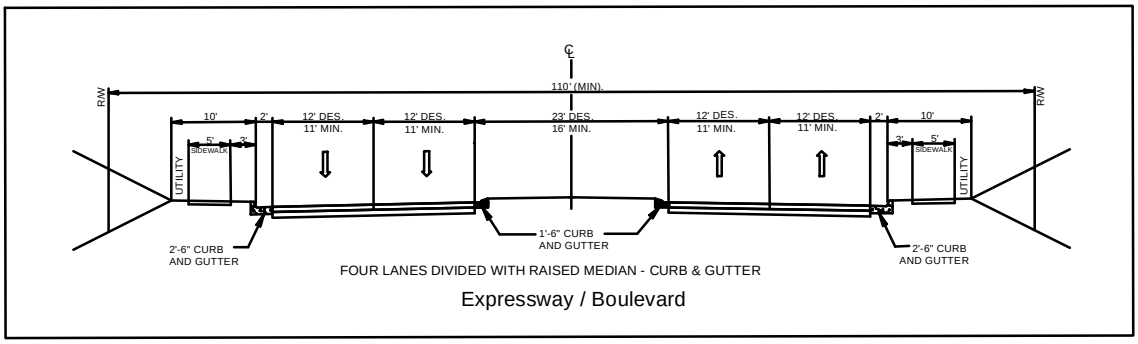
SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

Expressway / Boulevard

revised 04-01-05

TYPICAL HIGHWAY CROSS SECTIONS

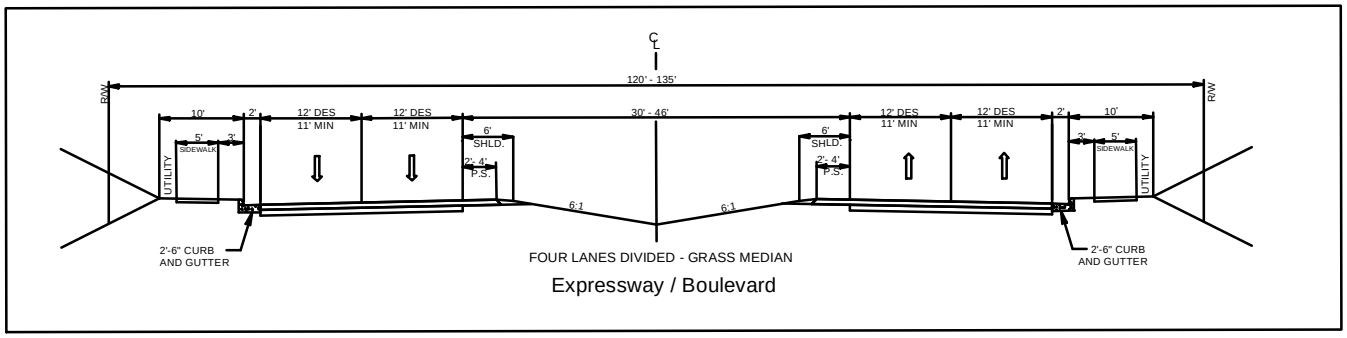
E



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

Expressway / Boulevard

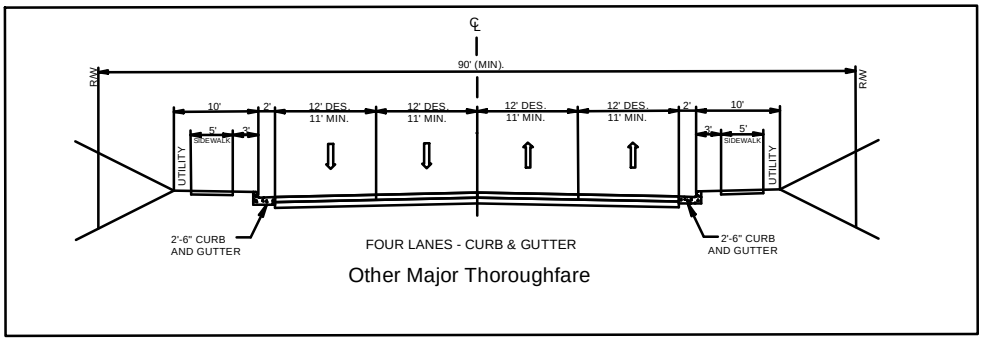
F



FOUR LANES DIVIDED - GRASS MEDIAN

Expressway / Boulevard

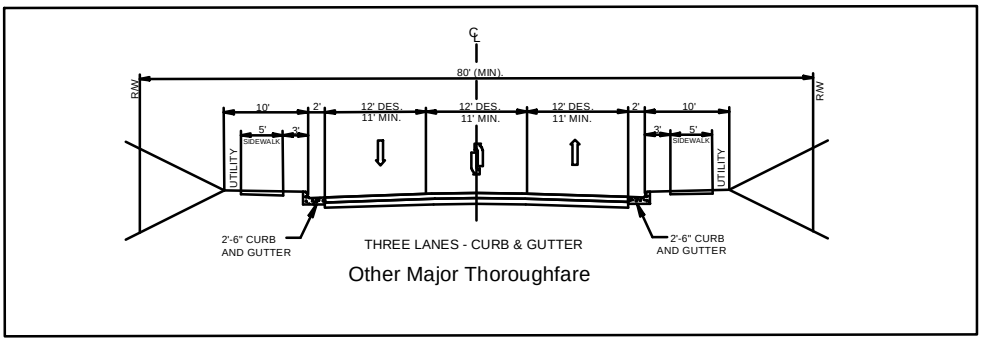
G



FOUR LANES - CURB & GUTTER

Other Major Thoroughfare

H

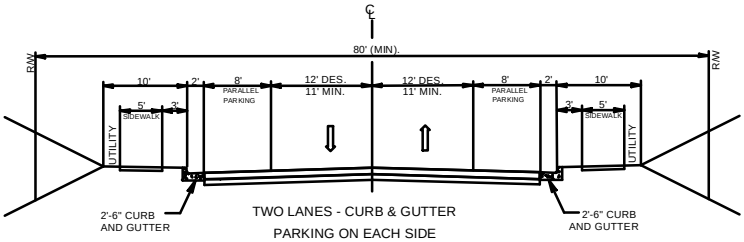


THREE LANES - CURB & GUTTER

Other Major Thoroughfare

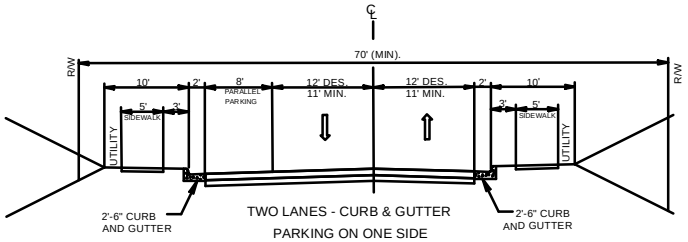
TYPICAL HIGHWAY CROSS SECTIONS

I



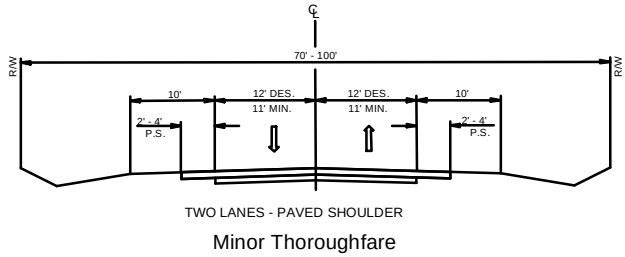
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE
Minor Thoroughfare

J



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE
Minor Thoroughfare

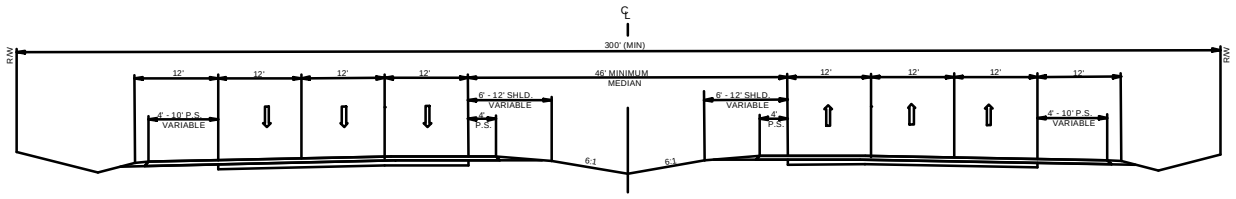
K



TWO LANES - PAVED SHOULDER
Minor Thoroughfare

TYPICAL HIGHWAY CROSS SECTIONS

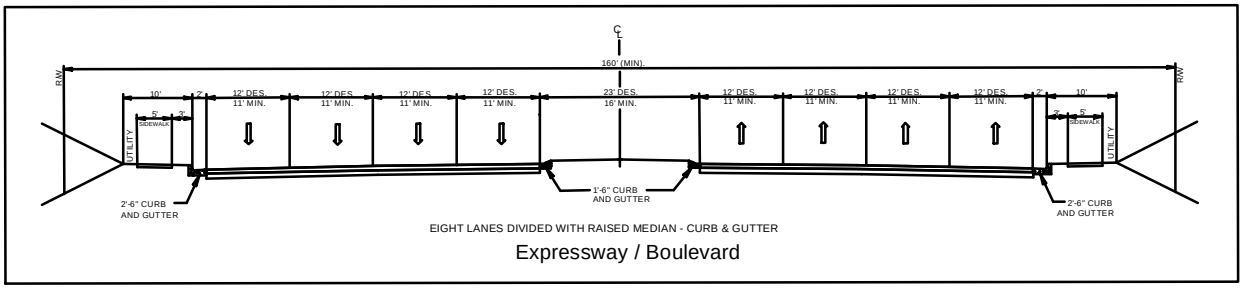
L



SIX LANES DIVIDED WITH GRASS MEDIAN

Freeway / Expressway

M



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

Expressway / Boulevard

Appendix D: Recommended Subdivision Ordinances

Definitions

Rural Roads

- **Principal Arterial** - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.
- **Minor Arterial** - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.
- **Major Collector** - A road that serves major intra-county travel corridors and traffic generators and provides access to the arterial system.
- **Minor Collector** - A road that provides service to small local communities and traffic generators and provides access to the major collector system.
- **Local Road** - A road that serves primarily to provide access to adjacent land over relatively short distances.

Urban Streets

- **Major Thoroughfares** - Major thoroughfares consist of inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.
- **Minor Thoroughfares** - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.
- **Local Street** - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

- **Freeway, expressway, or parkway** - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.
- **Residential Collector Street** - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

- **Local Residential Street** - Cul-de-sacs, loop streets less than 2,500 feet in length, or streets less than 1.0 mile in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.
- **Cul-de-sac** - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.
- **Frontage Road** - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.
- **Alley** - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

- **Building Setback Line** - A line parallel to the street in front of which no structure shall be erected.
- **Easement** - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.
- **Lot** - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Subdivision

- **Subdivider** - Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.
- **Subdivision** - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets. The following shall not be included within this definition nor subject to these regulations:

    - the combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein
    - the division of land into parcels greater than 10 acres where no street right-of-way dedication is involved
    - the public acquisition, by purchase, of strips of land for the widening or the opening of streets
    - the division of a tract in single ownership whose entire area is no greater than 2 acres into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

- **Dedication** - A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.
- **Reservation** - Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Design Standards

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the thoroughfare plan, as adopted by the municipality. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

Right-of-way Widths

Right-of-way widths shall not be less than the following and shall apply except in those cases where right-of-way requirements have been specifically set out in the thoroughfare plan.

The subdivider will only be required to dedicate a maximum of 100 feet of right-of-way. In cases where over 100 feet of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 100 feet. On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than 60 feet in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated. Minimum right-of-way requirements are shown in **Table D-1**.

Area Classification	Functional Classification	Minimum ROW
Rural	Principal Arterial (Freeway)	350 feet
	Principal Arterial (Other)	200 feet
	Minor Arterial	100 feet
	Major Collector	100 feet
	Minor Collector	80 feet
	Local Road (see note #1)	60 feet
Urban	Major Thoroughfare	90 feet
	Minor Thoroughfare	70 feet
	Local Street	60 feet
	Cul-de-sac (see note #2)	variable
1) The desirable minimum right-of-way is 60 feet. If curb and gutter is provided, 50 feet of ROW is adequate on local residential streets.		
2) The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.		

Table D-1: Minimum Right-of-way Requirements

Street Widths
Widths for street and road classifications other than local shall be as recommended by the thoroughfare plan. Width of local roads and streets shall be as follows:

- **Local Residential**
  - Curb and Gutter section - 26 feet, face to face curb
  - Shoulder section - 20 feet to edge of pavement, 4 feet for shoulders

- **Residential Collector**
  - Curb and Gutter section - 34 feet, face to face of curb
  - Shoulder section - 20 feet to edge of pavement, 6 feet for shoulders

Geometric Characteristics
The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under right-of-way shall apply.

- **Design Speed** - The design speed for a roadway should be a minimum of 5 mph greater than the posted speed limit. The design speeds for subdivision type streets are shown in **Table D-2**.
- **Minimum Sight Distance** - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters set forth in **Table D-3**.
- **Superelevation** - **Table D-4** shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway

superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

- **Maximum and Minimum Grades** - The maximum grades in percent are shown in **Table D-5**. Minimum grade should not be less than 0.5%. Grades for 100 feet each way from intersections (measured from edge of pavement) should not exceed 5%.

Facility Type		Design Speed (mph)		
		Desirable	Minimum	
			Level	Rolling
Rural	Minor Collector Roads (ADT over 2000)	60	50	40
	Local Roads (ADT over 400)[1]	50	50*	40*
Urban	Major Thoroughfares[2]	60	50	40
	Minor Thoroughfares	40	30	30
	Local Streets	30	30**	20**
[1] Local Roads including Residential Collectors and Local Residential				
[2] Major Thoroughfares other than Freeways and Expressways				
* Based on an ADT of 400 - 750. Where roads serve a limited area and small number of units, can reduce minimum design speed.				
** Based on projected ADT of 50 - 250. (Reference NCDOT Roadway Design Manual page 1-1B)				

Table D-2: Design Speeds

Design Speed	Stopping Sight		Minimum K Values		Passing Sight Distance (feet)
	Desirable	Minimum	Crest Curve	Sag Curve	
30	200	200	30	40	1100
40	325	275	60	60	1500
50	475	400	110	90	1800
60	650	525	190	120	2100
Note: General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case. (Reference: "NCDOT Roadway Design Manual" pg.1-12 T-1)					
[1] K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordan					

Table D-3: Sight Distance

Design Speed	Minimum Radius of Maximum e[1]			Maximum Degree of Curve		
	e = 0.04	e = 0.06	e = 0.08	e = 0.04	e = 0.06	e = 0.08
30	302	273	260	19 00'	21 00'	22 45'
60	573	521	477	10 00'	11 15'	12 15'
80	955	955	819	6 00'	6 45'	7 30'
100	1,637	1,432	1,146	3 45'	4 15'	4 45'
[1] e = rate of superelevation, foot per foot						
Reference: "NCDOT Roadway Design Manual," pg. 1-12 T-6 thru T-8						

Table D-4: Superelevation

Facility Type		Design Speed	Minimum Grade in Percent		
			Flat	Rolling	Mountainous
Rural	Minor Collector Roads*	20	7	10	12
		30	7	9	10
		40	7	8	10
		50	6	7	9
		60	5	6	8
		70	4	5	6
	Local Roads*[1]	20	-	11	16
		30	7	10	14
		40	7	9	12
		50	6	8	10
		60	5	6	-
Urban	Major Thoroughfares[2]	30	8	9	11
		40	7	8	10
		50	6	7	9
		60	5	6	8
	Minor Thoroughfares*	20	9	12	14
		30	9	11	12
		40	9	10	12
		50	7	8	10
		60	6	7	9
		70	5	6	7
	Local Streets*	20	-	11	16
		30	7	10	14
		40	7	9	12
		50	6	8	10
		60	5	6	-
* For streets and roads with projected annual average daily traffic less than 250 or short grades less than 500 feet long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)					
[1] Local Roads including Residential Collectors and Local Residential					
[2] Major Thoroughfares other than Freeways or Expressways					

Table D-5: Maximum Vertical Grade

Intersections

- Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.
- Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.
- Off-set intersections are to be avoided. Intersections, which cannot be aligned, should be separated by a minimum length of 200 feet between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than 500 feet in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

- Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.
- The width of an alley shall be at least 20 feet.
- Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets to Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 30 feet form the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of six feet from the face of curb.

Wheel Chair Ramps
All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck
The clear roadway widths for new and reconstructed bridges serving two lane, two way traffic should be as follows:

- shoulder section approach:
    - under 800 ADT design year - minimum 28 feet width face to face of parapets, rails, or pavement width plus 10 feet, whichever is greater,
    - 800 – 2,000 ADT design year - minimum 34 feet width face to face of parapets, rails, or pavement width plus 12 feet, whichever is greater,
    - over 2,000 ADT design year - minimum width of 40 feet, desirable width of 44 feet width face to face of parapets or rails;

- curb and gutter approach:
    - under 800 ADT design year - minimum 24 feet face to face of curbs,
    - over 800 ADT design year - width of approach pavement measured face to face of curbs,
    - where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face curbs, and in crown drop; the distance from face of curb to face of parapet or rail shall be a minimum of 1.5 feet or greater if sidewalks are required.

The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

- shoulder section approach:
    - width of approach pavement plus width of usable shoulders on the approach left and right (shoulder width 8 feet minimum, 10 feet desirable);

- curb and gutter approach:
    - width of approach pavement measured face to face of curbs.

Appendix E: Resources and Contacts

North Carolina Department of Transportation

Customer Service Office
1-877-DOT4YOU
(1-877-368-4968)

Secretary of Transportation
1501 Mail Service Center
Raleigh, NC 27699-1501
(919) 733-2520

Board of Transportation Member
Contact information for the current Board of Transportation Member may be accessed from the NCDOT homepage on the worldwide web *(http://www.ncdot.org/board/)* or by calling 1-877-DOT4YOU.

Highway Division 5

Division Engineer
Contact the Division Engineer with general questions concerning NCDOT activities within Division 5 or information on Small Urban Funds.

2612 N. Duke St.
Durham, NC 27704
(919) 560-6851

Division Construction Engineer
Contact the Division Construction Engineer for information concerning major roadway improvements under construction.

2612 N. Duke St.
Durham, NC 27704
(919) 560-6853

Division Traffic Engineer
Contact the Division Traffic Engineer for information concerning high-collision locations.

2612 N. Duke St.
Durham, NC 27704
(919) 560-6856

District Engineer
Contact the District Engineer for information regarding Driveway Permits, Right of Way Encroachments, and Development Reviews.

321 Gillburg Rd.
Henderson, NC 27537
(252) 492-0111

County Maintenance Engineer
Contact the County Maintenance Engineer regarding any maintenance activities, such as drainage.

Route 4, Box 703
Warrenton, NC 27589
(252) 257-3938

Centralized Personnel

Transportation Planning Branch

Contact the Transportation Planning Branch with long-range planning questions.

1554 Mail Service Center
Raleigh, NC 27699-1554
(919) 733-4705

Secondary Roads Office

Contact the Secondary Roads Officer for information regarding the Industrial Access Funds Program.

1535 Mail Service Center
Raleigh, NC 27699-1535
(919) 733-3250

Program Development Branch

Contact the Program Development Branch for information concerning Roadway Official Corridor Maps and the Transportation Improvement Program (TIP).

1542 Mail Service Center
Raleigh, NC 27699-1542
(919) 733-2031

Project Development & Environmental Analysis Branch

Contact PDEA for information on environmental studies for projects that are included in the TIP.

1548 Mail Service Center
Raleigh, NC 27699-1548
(919) 733-3141

Traffic Engineering & Safety Systems Branch

Contact the Traffic Engineering & Safety Systems Branch for information regarding Development Reviews.

1561 Mail Service Center
Raleigh, 27699-1561
(919) 733-3915

Highway Design Branch

Contact the Highway Design Branch for information regarding alignments for projects that are included in the TIP.

1584 Mail Service Center
Raleigh, 27699-1584
(919) 250-4001

Bicycle and Pedestrian Division

Contact the Bicycle and Pedestrian Division for information regarding projects in the TIP, funding, and events.

1552 Mail Service Center
Raleigh, 27699-1552
(919) 733-2804

Public Transportation Division

Contact the Public Transportation Division for information regarding planning funding for public transportation.

1550 Mail Service Center
Raleigh, 27699-1550
(919) 733-4713

Railroad Division

Contact the Railroad Division for information regarding engineering and safety, operations, and planning.

1553 Mail Service Center
Raleigh, 27699-1553
(919) 733-7245

Other departments

Contact information for other departments within the NCDOT not listed here are available at the NCDOT homepage on the worldwide web (http://www.ncdot.org/board/) or by calling 1-877-DOT4YOU.